

Docket No.: 20506/0204309-US0  
(PATENT)

**IN THE UNITED STATES PATENT AND TRADEMARK OFFICE**

**In re** Patent Application of:  
Euijoon Yoon et al.

Application No.: Not Yet Assigned

Confirmation No.: N/A

Filed: Concurrently Herewith

Art Unit: N/A

**For: GROWTH METHOD OF NITRIDE  
SEMICONDUCTOR LAYER AND LIGHT  
EMITTING DEVICE USING THE GROWTH  
METHOD**

Examiner: Not Yet Assigned

**INFORMATION DISCLOSURE STATEMENT (IDS)**

Commissioner for Patents  
P.O. Box 1450  
Alexandria, VA 22313-1450

Dear Sir:

Pursuant to 37 CFR 1.56, 1.97 and 1.98, the attention of the Patent and Trademark Office is hereby directed to the references listed on the attached PTO/SB/08. It is respectfully requested that the information be expressly considered during the prosecution of this application, and that the references be made of record therein and appear among the "References Cited" on any patent to issue therefrom.

This Information Disclosure Statement accompanies the new patent application submitted herewith.

Applicant has not submitted copies of each cited U.S. patent and U.S. patent application as required by 37 CFR 1.98(a)(2)(i), amended October 2004, as the U.S. Patent and Trademark Office has waived this requirement for all U.S. patent applications. Applicant submits herewith copies of foreign and non-patents in accordance with 37 CFR 1.98(a)(2).

Other information being provided for the examiner's consideration follows:

A Written Opinion of the International Searching Authority, mailed May 12, 2005; and a corresponding International Search Report (ISR), mailed May 12, 2005 are enclosed, both of which issued during the prosecution of International Application No. PCT/KR2004/002688.

Cite Nos. BA and BB are not in the English language. In accordance with 1.98(c), Applicant states that an English translation of each document (or of the pertinent portions thereof), or a copy of each corresponding English-language patent or application, or English-language abstract (or claim) is enclosed.

In accordance with 37 CFR 1.97(g), the filing of this Information Disclosure Statement shall not be construed to mean that a search has been made or that no other material information as defined in 37 CFR 1.56(a) exists. In accordance with 37 CFR 1.97(h), the filing of this Information Disclosure statement shall not be construed to be an admission that any patent, publication or other information referred to therein is "prior art" for this invention unless specifically designated as such.

It is submitted that the Information Disclosure Statement is in compliance with 37 CFR 1.98 and the Examiner is respectfully requested to consider the listed references.

The Commissioner is authorized to charge any deficiency of up to \$300.00 or credit any excess in this fee to Deposit Account No. 04-0100.

Dated: May 31, 2006

Respectfully submitted,

By    
Richard J. Katz

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Substitute for form 1449A/BPTO		<b>Complete if Known</b>			
<b>INFORMATION DISCLOSURE STATEMENT BY APPLICANT</b>  (Use as many sheets as necessary)		Application Number	Not Yet Assigned		
		Filing Date	Concurrently Herewith		
		First Named Inventor	Euijoon Yoon		
		Art Unit	N/A		
		Examiner Name	Not Yet Assigned		
Sheet	1	of	1	Attorney Docket Number	20506/0204309-USO

U.S. PATENT DOCUMENTS					
Examiner Initials*	Cite No. <sup>1</sup>	Document Number	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear
		Number-Kind Code <sup>2</sup> (if known)			
	AA*	US-20040026699-A1	02-12-2004	Baur et al.	
	AB*	US-5,864,573	01-25-1999	Miura et al.	

FOREIGN PATENT DOCUMENTS					
Examiner Initials*	Cite No. <sup>1</sup>	Foreign Patent Document	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear
		Country Code <sup>2</sup> Number <sup>3</sup> Kind Code <sup>4</sup> (if known)			
	BA	JP-2004-095724	03-25-2004		
	BB	JP-09-036429	02-07-1997		
	BC	EP-1 403 910	03-31-2004		

\*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 608. Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant. <sup>1</sup> Applicant's unique citation designation number (optional). <sup>2</sup> See Kind Code of USPTO Patent Documents at [www.uspto.gov](http://www.uspto.gov) or MPEP 901.04. <sup>3</sup> Enter Office that issued the document, by the two-letter code (WIPO Standard ST.3). <sup>4</sup> For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. <sup>5</sup> Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. <sup>6</sup> Applicant is to place a check mark here if English language Translation is attached.

NON PATENT LITERATURE DOCUMENTS			
Examiner Initials*	Cite No. <sup>1</sup>	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc.), date, page(s), volume-issues number(s), publisher, city and/or country where published.	T <sup>2</sup>

\*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 608. Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

<sup>1</sup> Applicant's unique citation designation number (optional). <sup>2</sup> Applicant is to place a check mark here if English language Translation is attached.

Examiner Signature		Date Considered	
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## PATENT COOPERATION TREATY

From the  
INTERNATIONAL SEARCHING AUTHORITY

To:

AN, Sang Jeong

512-1906 221, Gumi-dong, Bundang-gu Seongnam-si,  
Kyunggi-do 463-715, Republic of Korea

PCT

WRITTEN OPINION OF THE  
INTERNATIONAL SEARCHING AUTHORITY

(PCT Rule 43bis.1)

Date of mailing  
(day/month/year) 12 MAY 2005 (12.05.2005)

Applicant's or agent's file reference

04ep0901

FOR FURTHER ACTION

See paragraph 2 below

International application No.

PCT/KR2004/002688

International filing date (day/month/year)

20 OCTOBER 2004 (20.10.2004)

Priority date(day/month/year)

13 AUGUST 2004 (13.08.2004)

International Patent Classification (IPC) or both national classification and IPC

IPC7 H01L 33/00

Applicant

SEOUL NATIONAL UNIVERSITY INDUSTRY FOUNDATION et al

## 1. This opinion contains indications relating to the following items:

- ☒ Box No. I Basis of the opinion
- ☐ Box No. II Priority
- ☐ Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- ☐ Box No. IV Lack of unity of invention
- ☒ Box No. V Reasoned statement under Rule 43bis.1(a)(i) with regard to novelty, inventive step or industrial applicability, citations and explanations supporting such statement
- ☐ Box No. VI Certain documents cited
- ☐ Box No. VII Certain defects in the international application
- ☒ Box No. VIII Certain observations on the international application

## 2. FURTHER ACTION

If a demand for international preliminary examination is made, this opinion will be considered to be a written opinion of the International Preliminary Examining Authority ("IPEA") except that this does not apply where the applicant chooses an Authority other than this one to be the IPEA and the chosen IPEA has notified the International Bureau under Rule 66.1bis(b) that written opinions of this International Searching Authority will not be so considered.

If this opinion is, as provided above, considered to be a written opinion of the IPEA, the applicant is invited to submit to the IPEA a written reply together, where appropriate, with amendments, before the expiration of 3 months from the date of mailing of Form PCT/ISA/220 or before the expiration of 22 months from the priority date, whichever expires later.

For further options, see Form PCT/ISA/220.

## 3. For further details, see notes to Form PCT/ISA/220.

Name and mailing address of the ISA/KR



Korean Intellectual Property Office  
920 Daesang-dong, Seo-gu, Daejeon 302-701,  
Republic of Korea

Facsimile No. 82-42-472-7140

Authorized officer

KIM, Dong Yup

Telephone No. 82-42-481-5749



WRITTEN OPINION OF THE  
INTERNATIONAL SEARCHING AUTHORITY

International application No.

PCT/KR2004/002688

Box No. 1 Basis of this opinion

1. With regard to the language, this opinion has been established on the basis of the international application in the language in which it was filed, unless otherwise indicated under this item.
- ☐ This opinion has been established on the basis of a translation from the original language into the following language \_\_\_\_\_, which is the language of a translation furnished for the purposes of international search (under Rules 12.3 and 23.1(b)).
2. With regard to any nucleotide and/or amino acid sequence disclosed in the international application and necessary to the claimed invention, this opinion has been established on the basis of:
- a. type of material
- ☐ a sequence listing
- ☐ table(s) related to the sequence listing
- b. format of material
- ☐ in written format
- ☐ in computer readable form
- c. time of filing/furnishing
- ☐ contained in the international application as filed.
- ☐ filed together with the international application in computer readable form.
- ☐ furnished subsequently to this Authority for the purposes of search.
3. ☐ In addition, in the case that more than one version or copy of a sequence listing and/or table relating thereto has been filed or furnished, the required statements that the information in the subsequent or additional copies is identical to that in the application as filed or does not go beyond the application as filed, as appropriate, were furnished.
4. Additional comments:

**WRITTEN OPINION OF THE  
INTERNATIONAL SEARCHING AUTHORITY**

International application No.

PCT/KR2004/002688

**Box No. V Reasoned statement under Rule 43bis.1(a)(i) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**

**1. Statement**

Novelty (N)	Claims 1-23	YES
	Claims NONE	NO
Inventive step (IS)	Claims 1-23	YES
	Claims NONE	NO
Industrial applicability (IA)	Claims 1-23	YES
	Claims NONE	NO

**2. Citations and explanations:**

**1) Reference is made to the following documents:**

01 : JP 2004- 95724 A	02 : US 2004/0026699 A1	
03 : JP 9-36429 A	04 : US 5864573 A	05 : EP 1403910-A2

**2) Novelty and Inventive Step**

The present application is related to a method of growing III-V semiconductor light emitting device and an LED using the growth method.

The growth method comprises at least: the first step to form a first Nitride semiconductor layer on a AlGaInN layer; the second step to reduce the thickness of the above first Nitride semiconductor layer; and the third step to form a second Nitride semiconductor layer having a larger band gap energy than a first Nitride semiconductor layer. (Claims 1-10)

The LED comprises: a substrate; a AlGaInN layer; a In-rich quantum well layer; a Nitride semiconductor layer having a larger band gap energy than the quantum well; a first composition gradient layer formed between the AlGaInN layer and quantum well layer; and a second composition gradient layer formed between the quantum well layer and the upper layer. (Claims 11-23)

D1 discloses a Nitride semiconductor light emitting diode in which an active layer is formed on a clad layer. The active layer has a structure where a plurality of island-shaped parts consisting of InN are arrayed on the same plane. In D1, the first step for the growth of InN layer is similar to that of this application because the ratio of NH<sub>3</sub>/TM is 660,000:1 (paragraph [0036]). But there is no description about the reduction of the InN layer in D1, and the quantum well structure explained in D1 is different from that of this application.

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WRITTEN OPINION OF THE  
INTERNATIONAL SEARCHING AUTHORITY

International application No.

PCT/KR2004/002688

Box No. VIII Certain observations on the international application

The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made:

1. Claim 3 does not meet the requirements of Article 6 PCT in that the matter for which protection is sought is not clearly defined, because the expression of "the extremely low content of Ga source" is vague.
2. Claim 16 does not meet the requirements of Article 6 PCT in that the matter for which protection is sought is not clearly defined, because "In(0.2-0.5)Ga(0.8-0.5)N" cannot be classified as In-rich composition.
3. Claim 21 does not appear to be properly supported by the description because there is no explanation about the number of the quantum well / barrier layers in the description of the invention.
4. The expression of "1-2 ML" on page 5, line 3 is not clear.

WRITTEN OPINION OF THE  
INTERNATIONAL SEARCHING AUTHORITY

International application No.

PCT/KR2004/002688

Supplemental Box

In case the space in any of the preceding boxes is not sufficient.  
Continuation of:

BOX V.

D2 discloses a light-emitting diode in which over a substrate, a series of epitaxial layers with a radiation-emitting active structure based on InGaIn is disposed. Between the substrate and the active structure, a buffer layer is provided. The active structure has "In-rich zones", disposed laterally side by side relative to the epitaxial plane, in which zones the In content is higher than in other regions of the active structure. The concept of In-rich quantum well layer is described D1, but there is no explanation about the reduction of the thickness of the quantum well layer or about the composition gradient layer in the Nitride semiconductor LED.

D3 discloses a manufacturing method of III-V Nitride semiconductor. A buffer layer is grown on a substrate followed by growth of a GaAlN layer, a first layer of III-V compound semiconductor represented by InGaIn, and a second layer represented by formula InGaAlN. A quantum well layer by employing a double heterostructure where the band gap of the outer layers is larger than that of the quantum well layer. It is similar to this application in a point that the supplement of III-elements stops before the second layer is formed. But there is no description about the reduction of the thickness of the quantum well layer or about the composition gradient layer in the Nitride semiconductor LED in D3.

D4 explains a compound semiconductor light emitting devices including a GaP substrate, a buffer layer consisting of InN which is formed on the substrate, a relaxation layer consisting of In<sub>0.5</sub>Ga<sub>0.5</sub>N which is formed on the buffer layer, and a luminescent layer consisting of In<sub>0.5</sub>Ga<sub>0.5</sub>N which is formed on the relaxation layer. But the above structure is a basic Nitride semiconductor light emitting diode including InGaIn luminescent layer.

D5 also discloses an elementary compound semiconductor light emitting devices including InN / InGaIn multi-layered layer.

Although D1-D5 declare a Nitride semiconductor light emitting diode consists of InGaIn based active layer, none of the documents D1-D5 refer to the reduction of the thickness of the quantum well layer by stopping the supplement of III elements or to the composition gradient layers in the Nitride semiconductor LED.

D1-D5 are thus considered to be little relevance to the present application.

-continued-

**WRITTEN OPINION OF THE  
INTERNATIONAL SEARCHING AUTHORITY**

**International application No.**

**PCT/KR2004/002688**

**Supplemental Box**

**In case the space in any of the preceding boxes is not sufficient.**  
**Continuation of:**

BOX V.

Compared with the prior arts as cited in the International Search Report, the present invention(claims 1-23) is believed to be novel and to involve an inventive step under PCT Article 33(2) and 33(3).

**3) Industrial Applicability**

And the present invention has an industrial applicability under PCT Article 33(4).

## PATENT COOPERATION TREATY

## INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference 04op0901	<b>FOR FURTHER ACTION</b>		see Form PCT/ISA/220 as well as, where applicable, item 5 below.
International application No. <b>PCT/KR2004/002688</b>	International filing date (day/month/year) <b>20 OCTOBER 2004 (20.10.2004)</b>	(Earliest) Priority Date (day/month/year) <b>13 AUGUST 2004 (13.08.2004)</b>	
Applicant <b>SEOUL NATIONAL UNIVERSITY INDUSTRY FOUNDATION et al</b>			

This International search report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This international search report consists of a total of 3 sheets.

☐ It is also accompanied by a copy of each prior art document cited in this report.

## 1. Basis of the report

- a. With regard to the language, the international search was carried out on the basis of the international application in the language in which it was filed, unless otherwise indicated under this item.

☐ The international search was carried out on the basis of a translation of the international application furnished to this Authority (Rule 23.1(b)).

- b. ☐ With regard to any nucleotide and/or amino acid sequence disclosed in the international application, see Box No. I.

2. ☐ Certain claims were found unsearchable (See Box No. II)

3. ☐ Unity of invention is lacking (See Box No. III)

4. With regard to the title,

☒ the text is approved as submitted by the applicant.

☐ the text has been established by this Authority to read as follows:

5. With regard to the abstract,

☒ the text is approved as submitted by the applicant.

☐ the text has been established, according to Rule 38.2(b), by this Authority as it appears in Box No. IV. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority.

6. With regard to the drawings,

- a. the figure of the drawings to be published with the abstract is Figure No. 1

☒ as suggested by the applicant.

☐ because the applicant failed to suggest a figure.

☐ because this figure better characterizes the invention.

- b. ☐ none of the figure is to be published with the abstract.

**A. CLASSIFICATION OF SUBJECT MATTER****IPC7 H01L 33/00**

According to International Patent Classification (IPC) or to both national classification and IPC

**B. FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)

IPC7 H01L H01S

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Korean Patents and applications for inventions since 1975

Korean Utility models and applications for Utility models since 1975

Japanese Utility models and application for Utility models since 1975

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

e-KIAPSS "InGaN", "NITROGEN", "GROW"

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 2004- 95724 A ( NIPPON TELEGR. & TELEPH. CORP. <NTT> ) 25 MARCH 2004 see the abstract, claims 1-5, the embodiment 1 ( paragraph [0028]-[0064])	1 - 23
A	US 2004/0026699 A1 ( JOHANNES BAUR et al. ) 12 FEBRUARY 2004 see the abstract, figure 1a	1 - 23
A	JP 9-36429 A ( SUMITOMO CHEM. CO. LTD. ) 7 FEBRUARY 1997 see the abstract, embodiment 1, figures 1-2	1 - 23
A	US 5864573 A ( SUMITOMO ELECTRIC INDUSTRIES LTD. ) 26 JANUARY 1999 see the whole document	1 - 23
A	EP 1403910 A2 ( CHIBA UNIVERSITY ) 31 MARCH 2004 see the whole document	1 - 23

☐ Further documents are listed in the continuation of Box C.☒ See patent family annex.

## \* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is considered with one or more other such documents, such combination being obvious to a person skilled in the art

"&amp;" document member of the same patent family

Date of the actual completion of the international search

11 MAY 2005 (11.05.2005)

Date of mailing of the international search report

12 MAY 2005 (12.05.2005)

Name and mailing address of the ISA/KR

Korean Intellectual Property Office  
920 Dunsan-dong, Seo-gu, Daejeon 302-701,  
Republic of Korea

Facsimile No. 82-42-472-7140

Authorized officer

KIM, Dong Yup

Telephone No. 82-42-481-5749



**INTERNATIONAL SEARCH REPORT**  
Information on patent family members

International application No.  
PCT/KR2004/002688

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
JP 2004- 95724 A	25.03.2004	EP 1388814 A2	18.02.2004
		EP 1388814 A3	26.01.2005
		JP 16022969 A	22.01.2004
		JP 16022970 A	22.01.2004
		KR 1020040002471	07.01.2004
		US 2003234404 A1	25.12.2003
US 2004/0026699 A1	12.02.2004	EP 1299909 A1	09.04.2003
		DE 10032246 A1	17.01.2002
		JP 2004503096 T2	29.01.2004
		TW 518770 B	21.01.2003
		WO 0203479 A1	10.01.2002
JP 9-36429 A	07.02.1997	NONE	
US 5864573 A	26.01.1999	JP 08293473 A	05.11.1996
EP 1403910 A2	31.03.2004	JP 2004140339 A	13.05.2004
		CA 2441877 A1	25.03.2004
		CN 1497743 A	19.05.2004
		KR 1020040027390 A	01.04.2004
		US 6856005 B6	15.02.2005
		US 20040108500 A1	10.06.2004